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Mike Hutt, U.S. Geological Survey

As the authority on the health of our nation's environment and ecosystems, the U.S. Geological Survey (USGS) is charged with understanding the threats facing our nation's landscape and providing information about how we can best address them. In recent years, USGS has been using a new tool in its efforts that allow it to reach previously unreachable areas, safely survey difficult terrain through dangerous conditions and use advanced technology to produce the best possible information for our government to make informed decisions necessary to protect our environment, natural resources and overall quality of life. That tool is unmanned aerial systems (UAS). Recently, Increasing Human Potential spoke with Mike Hutt, the UAS Project Manager for USGS about how his agency is using UAS technology to more effectively and efficiently gather data from remote islands in the Pacific, to the sands of the Mojave Desert and everywhere in between.

When did USGS begin using UAS in your research?

The USGS use of UAS technology goes back to 2004 when a UAS was used to acquire data during a volcanic event on Mount Saint Helens. After carefully monitoring the rapid advancements in the technology, USGS determined that UAS had reached a maturity stage and was ready to be employed for scientific, environmental and land management applications. The USGS UAS Project Office was created in May of 2008 to enable cost-effective and safe UAS technology into the Department of the Interior's decision making toolbox. Since then we have worked across the Department of the Interior Agencies, the Department's Office of Aviation Services, Department of Defense, Federal Aviation Administration and others to acquire systems, initiate operator training programs, certify the airworthiness of platforms and conduct missions. Much like the use of internet technology, Geographic Information Systems (GIS) and Global Positioning Systems (GPS), unmanned aircraft systems have the potential of enabling us to be better stewards of the land.

One of USGS' upcoming projects is inspecting and monitoring wildlife on Palmyra atoll in the Pacific. Can you tell us more about this project and how UAS are helping with your research?

Palmyra is one of the last uninhabited islands or atolls in the Pacific Ocean. USGS scientists work closely with the US Fish and Wildlife Service, The Nature Conservancy, and fellow Palmyra Atoll Research Consortium scientists to monitor and gain a better understanding of the key biophysical properties associated with ecosystem process, climate change, and hydrology of the atoll. Due to the extreme remoteness of the island, it has been very difficult to acquire aerial imagery, and satellite systems are not of a sufficient resolution to support many of the scientific investigations. The UAS equipped with digital high definition thermal and color cameras will fly over the lagoon or hover in a position for studying water flow, nesting bird colonies, sea turtles and coral reefs. The UAS will provide a cost-effective opportunity to research and further develop techniques to measure biophysical and ecosystem properties. The UAS mission will provide a unique opportunity to correlate the ground measurements to the remote sensing data to improve the hydrologic, thermal, and landscape assessments of aquatic wildlife, atoll vegetation, hydrologic changes and bird habitat and behavior.

From the Pacific to the Mojave Desert to West Virginia to Hawaii, USGS seems to be using UAS in a wide array of places. What makes UAS so adaptable to different locations?

The Department of the Interior manages over 500 million acres or about 1/5 of United States. The management responsibilities are complex and require intricate, timely information. UAS technology is being evaluated by scientists, resource managers and emergency management staff for a wide range of applications. UAS provides the USGS, and our partners, with a cost effective capability to gain access to an increased level of persistent monitoring of earth surface processes in remote areas that have been difficult or nearly impossible to access before. The small size of a sUAS (under 20 pounds) makes it very easy to transport them across the country using overnight mail delivery systems. The most exciting development is the miniaturization and variety of readily available sensor packages. Using a sUAS, we are able to tailor solutions to meet project requirements. We can obtain very high resolution video, acquire thermal imagery, detect chemical plumes, collect point cloud data and locate animals that have been tagged with tracking devices at a fraction of the cost of conventional surveying methods. UAS technology will allow us to do more with less and in the process enhance our ability to provide unbiased scientific information to better enable decision makers to make informed decisions.

What other types of research projects is USGS currently using unmanned systems for?

UAS technology is being made available to monitor environmental conditions, analyze the impacts of climate change, respond to natural hazards, understand landscape change rates and consequences, conduct wildlife inventories and support related land management missions. The wildlife biologists were the first implementers of the technology (monitoring and inventorying wildlife), followed by geologists (detecting landslides, mapping fault zones), hydrologists (monitoring shoreline erosion, and stream temperature gradients) and ecologists (habitat mapping). The public safety components of the Department are very interested in using UAS to support their missions including search and rescue, monitoring pipelines and wildland fire fighting.

What are the benefits of using unmanned systems for USGS research?

Using UAS provides scientists a way to look longer, closer, and more frequently at some of the most remote areas of the Earth, places that were previously too dangerous or too expensive to monitor in detail. The flexibility of operations and relative low cost of small unmanned aircraft systems enhances our ability to track long-term landscape change. In addition, we can quickly assess landscape altering events, such as wildfires or volcanoes, in areas with challenging logistics. In many cases, UAS technology is simply the only cost effective way to gather earth observation data for a wide variety of applications: managing federal lands; investigating climate change; mapping and charting; conducting environmental risk assessments; responding to and recovering from natural and human-induced disasters.

Why is it beneficial to use UAS as opposed to a helicopter or small plane?

Manned aircraft flights may not always be feasible due to concerns with long flight durations, requirement for low altitude flying, hazardous weather conditions, and associated operations cost. Satellite-based observations can be hindered by coarse image resolution, atmospheric conditions, limited sensor capabilities, and repeat orbiting cycles of days or weeks. The use of UAS technology allows flexibility in delivering timely data. Furthermore, data collection by UAS can be specifically tailored to the required resolution and radiometric parameters of individual investigations. Our goal is to recognize a 10-1 cost savings by using a sUAS over traditional manned aircraft.

What kinds of UAS is USGS using in its research?

USGS is currently using the AeroVironment Raven and Honeywell T-Hawk. The Raven is a 4.4 pound aircraft and the T-Hawk is a 20 pound hovercraft. We are operating sUAS due to acquisition and operations cost considerations. The smaller systems flying under controlled conditions are likely to be the first UAS systems approved for routine use in the National Airspace System. We project that sUAS will eventually be considered a piece of field equipment much like GPS devices are today. However, the sUAS are designed to support short duration missions. We anticipate contracting for data services with commercial UAS vendors in the near future for large acquisition requirements (i.e. state or national aerial photography or LiDAR surveys).

For what type of projects do you see the USGS using UAS in the future?

UAS capabilities have demonstrated the ability to effectively fill the current observation gaps that are critical to gaining a better understanding of the complexities and scientific knowledge related to climate change research, water resources forecasting, ecosystem monitoring and management and natural hazards. These information gaps in our observations frequently exist over the remote, scarcely populated and often volatile lands managed by the Department of the Interior (North Slope of Alaska, Volcanic Islands, Everglades, the vast, desolate areas found in the intermountain West) and other remote reaches of the Earth. The use of UAS technology allows flexibility in delivering timely data, for longer durations (persistent staring – such as shared real-time video feeds), tailored to the required resolution and radiometric parameters. UAS technology expands our ability to obtain remotely sensed data to inventory and monitor dynamic landscape altering events and conduct impact analysis over previously logistically challenging areas.